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(56) Documents Cited
GB 2278754 A EP 0740451 A1 US 5418776 A
US 4794595 A US 4740963 A US 4381427 A

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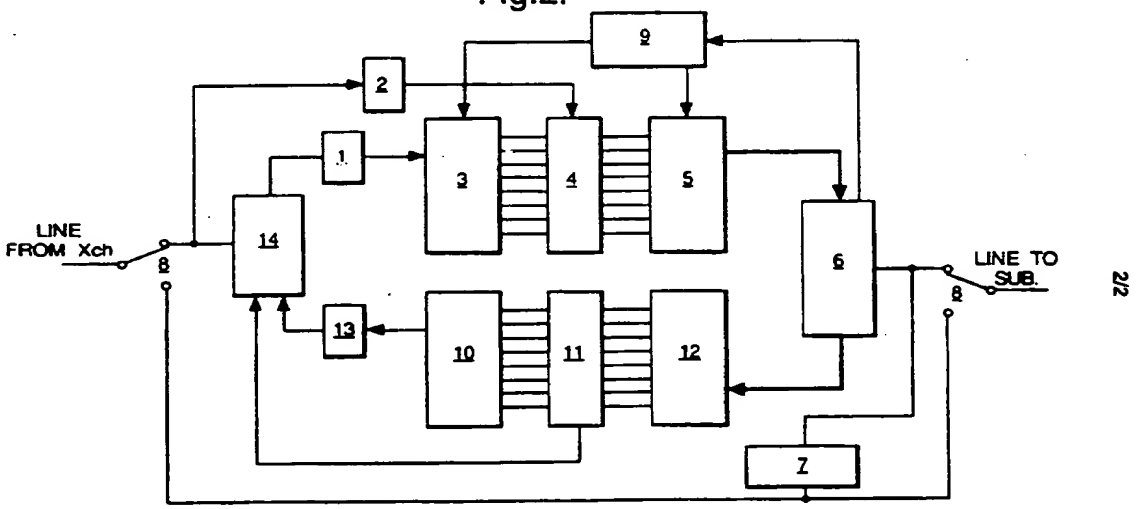
(54) **Broadband digital subscriber loop systems**

(57) A telecommunications system has broadband digital subscriber loop circuitry at each end of a link and is arranged to transmit telephony signals by digitising them and carrying them within the DSL signals whereby, in the event of failure of one of the DSL circuits or its associated power supply, the telephony signal is automatically switched to bypass the DSL circuits.

Fig.2.



1 ANTI ALIAS FILTER
2 RINGING DETECTOR
3 A LAW OR u LAW A TO D CONVERTER
4 RING DETECT BIT SET
5 ADDRESSING
6 DSL CIRCUITRY
7 HIGH IMPEDANCE BROADBAND DETECT
8 "FAIL TO SAFE" RELAYS
9 CLOCKING CIRCUITRY
10 A LAW OR u LAW D TO A CONVERTER
11 LINE SEIZURE BITS DETECT
12 ADDRESSING
13 POST DETECTION FILTER
14 2 TO 4 WIRE HYBRID AND LINE SEIZE

2/2

GB 2 313 979 A

At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

Fig.1.

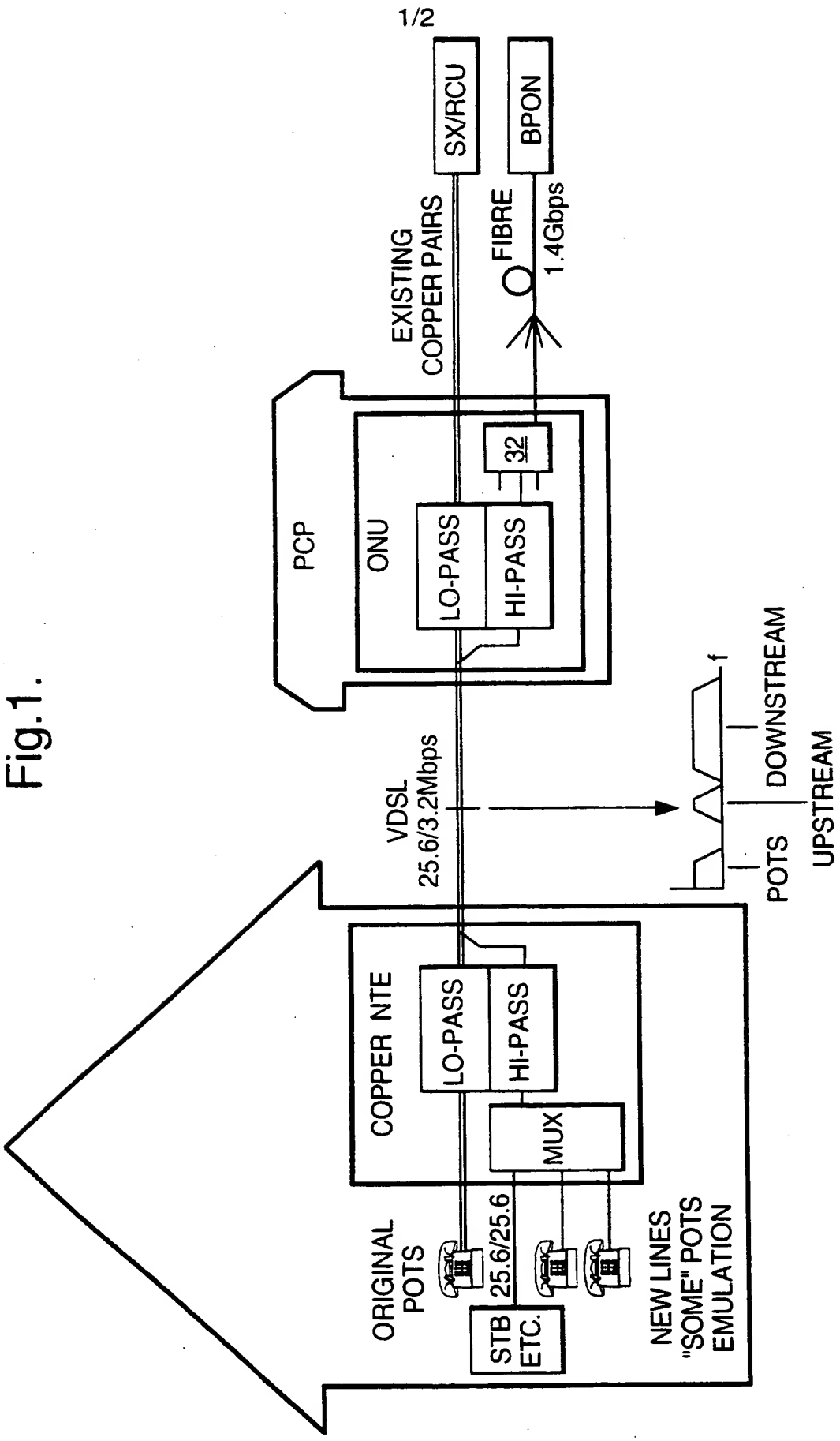
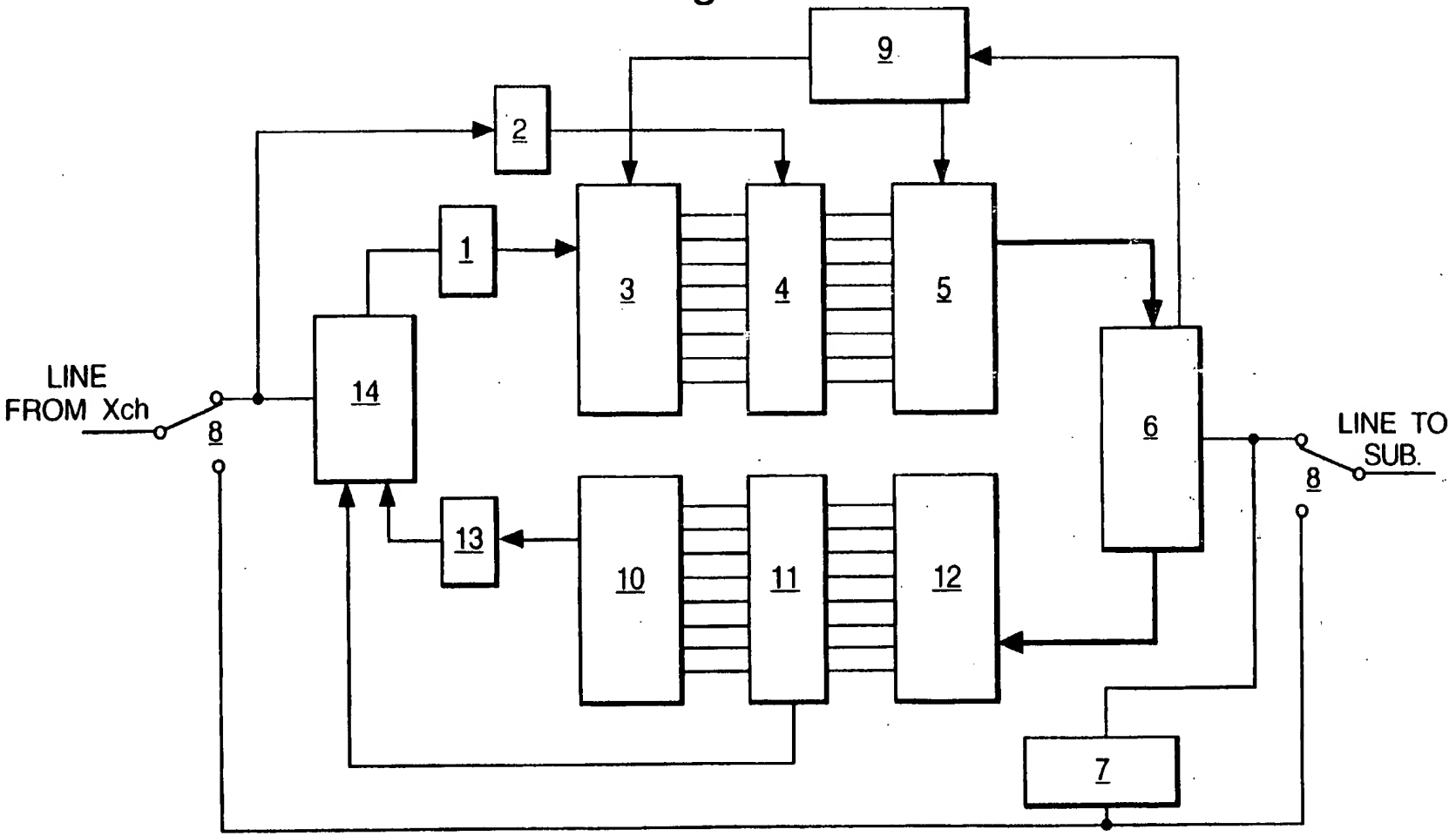


Fig.2.



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BROADBAND DIGITAL SUBSCRIBER LOOP SYSTEMS

A requirement of almost all telephone system operating companies who wish to provide future broadband services to their domestic and small business customers over existing telephone lines is a means whereby existing telephone services can continue to co-exist in the same line as the new broadband service.

This has been addressed in the past by the use of filters to separate the telephony signals and the broadband signals.

If the signals to be filtered were all of a voice frequency or above, bipolar nature, then the provision of these filters would be a relatively simple matter. However, whilst this is true of the Digital Subscriber Line (DSL) signals, those associated with a telephone set do not conform to this simple model. For historical reasons present day telephones still use a 70 volt, 25 Hertz ringing signal, operate bi-directionally over a single pair of wires and require a DC voltage to operate. All of this means that the filter used to separate the telephony signals and voltages must be either extremely complicated or use passive, inductive components in its construction.

Both of these choices lead to expense and bulk in the finished product, neither of which is desirable where the product must fit into a restricted volume at both ends of the DSL link and be affordable to the average customer.

As can be seen from Figure 1 a low pass filter is required at both the Primary Connection Point (PCP) and the customer's premises. This separates the telephone signals from the broadband signals.

As far as the signal paths are concerned between PCP and premises, Figure 1 is an accurate representation of the actual geometry of the system. It can be seen that the high pass filters are connected to the line in parallel to the low pass filters. This means that the high pass filters will both have to be robust enough to withstand ringing voltages and will also have to block the DC on the line and this will increase the expense of these filters as well.

A telephone line, from PCP to premises, is made up of a series of lengths of cable. These are joined at joints, distribution boxes and Secondary Connection Points (SCP). If these joints are corroded they will act as a diode, causing severe and unacceptable distortion to the broadband signal. To overcome this problem, a wetting current is required to "forward bias" the diode removing the possibility of distortion.

This wetting current, however, must be great enough to prevent broadband distortion but not so high that it causes the exchange or Remote Concentrator Unit (RCU) to mistake the current for the current which occurs when a telephone instrument is taken off hook. Considering that every telephone line will be of a different length and loop resistance, this balance will be very hard to judge.

An alternative solution is to terminate the analogue telephone signals at the PCP,

digitise them and carry the resultant data within the digital broadband circuit. This removes the requirement for the filters and allows the wetting current to be optimised for minimum distortion of the broadband signal.

A disadvantage of this approach is that if the complex DSL circuitry or the power fails at the NTE or ONU then no telephony service is available. Some telecommunications operators are required to provide emergency "lifeline" telephony service in these circumstances.

According to the present invention there is provided a telecommunications system having broadband digital subscriber loop circuitry at each end of a link and it being arranged to transmit telephony signals by digitising them and carrying them within the DSL signals whereby, in the event of failure of one of the DSL circuits or its associated power supply, the telephony signal is automatically switched to bypass the DSL circuits .

This concept is illustrated in Figure 2.

While power is available and a broadband DSL signal is present at the inputs to both ONU and NTE, then the telephone circuit will continue to be carried within the broadband signal. However, should power fail, or a lack of incoming signal indicate a power failure or other breakdown at the other end of the link, a set of relays will relax, bypassing the ONU and NTE and restoring the telephone circuit to direct metallic contact between exchange and instrument.

The circuitry shown is that associated with the PCP, hence the ringing detector. However, that associated with the NTE is essentially the same, with an "off hook" detector rather than a ringing detector.

A ringing detector is required at the PCP, with ringing to bit set circuitry associated with it. A ringing generator is required at the Network Terminating Equipment (NTE). Similarly, a line seizure detector is required at the NTE, with seizure to bit set associated circuitry. A line seizure relay will be required at the Optical Network Unit (ONU).

Block 7, the high impedance broadband detect circuit provides means by which the circuit can detect the presence or absence of a broadband signal from the far end of the line. If, in the relay position shown, the signal from the far end should cease, block 7 will detect this and will cause the relays to relax. This means that it is now impossible for block 7 to detect the presence of broadband signal from the input connected to the "energised" side of the relay. For this reason, block 7 has a second, high impedance input which will detect broadband signals from the bypass link. Once the broadband signal is restored from the far end, block 7 will detect this via this input, and cause to energise again.

Discrete Multi Tone Modulation (DMT) is a spectrally efficient means of transmitting data over analog media. In DMT a series of digital bytes of from 2 to 16 bits are transmitted simultaneously, each byte being modulated into a single tone of a

series of frequency divided tones, these tones being series contiguous and band limited.

One advantage of DMT over other modulation methods is the possibility to modulate an individual tone or group of tones separately from the remainder.

In one implementation of DMT modulation the 64 kbits/sec of data required for the telephony can be carried on a single tone simplifying the process by which the telephony is multiplexed with the broadband digital data.

CLAIMS

1. In a telecommunications system having broadband digital subscriber loop circuitry at each end of a link and arranged to transmit telephony signals by digitising them and carrying them within the DSL signals including means whereby, in the event of failure of one of the DSL circuits or its associated power supply, the telephony signal is automatically switched to bypass the DSL circuits .

2.A telecommunications system as claimed in Claim 1, wherein the DSL circuits use Discrete Multi Tone (DMT) modulation.

3. A telecommunications system as claimed in Claim 1 or 2, wherein the telephony signals are modulated onto a single carrier within the DMT signal.

4. A telecommunications system substantially as hereinbefore described, with reference to and as illustrated in Figure 2 of the accompanying drawings.

The Patent Office

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Application No: GB 9711785.7 **Examiner:** Ken Long
Claims searched: 1 to 4 **Date of search:** 27 August 1997

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H4K (KTL, KTP, KTX, KOT & K1L in KBHX)

Int Cl (Ed.6): H04M (3/08, 3/18, 3/20, 3/22, 3/24, 3/26, 3/30, 3/32 & 11/06)

Other: ONLINE : WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2278754 A	NORTHERN TELECOM (second complete paragraph on page 2 and lines 1 to 5 of page 5)	1
X	EP 0740451 A1	ALCATEL BELL (column 1 lines 3 to 8, column 3 lines 17 to 21 and column 3 line 33 to column 4 line 12)	1 to 3
X	US 5418776	AT&T (column 1 lines 23 to 35 and column 3 line 61 to column 4 line 26)	1
X	US 4794595	FUJITSU (column 1 lines 5 to 28 and column 2 lines 31 to 34 and 49 to 53)	1
X	US 4740963	LEAR SIEGLER (column 1 lines 18 to 33, column 2 line67 to column 3 line 7 and column 6 lines 30 to 33 and 45 to 48)	1
X	US 4381427	NORTHERN TELECOM (column 1 lines 5 to 11 and column 4 lines 11 to 19)	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Fig.1.

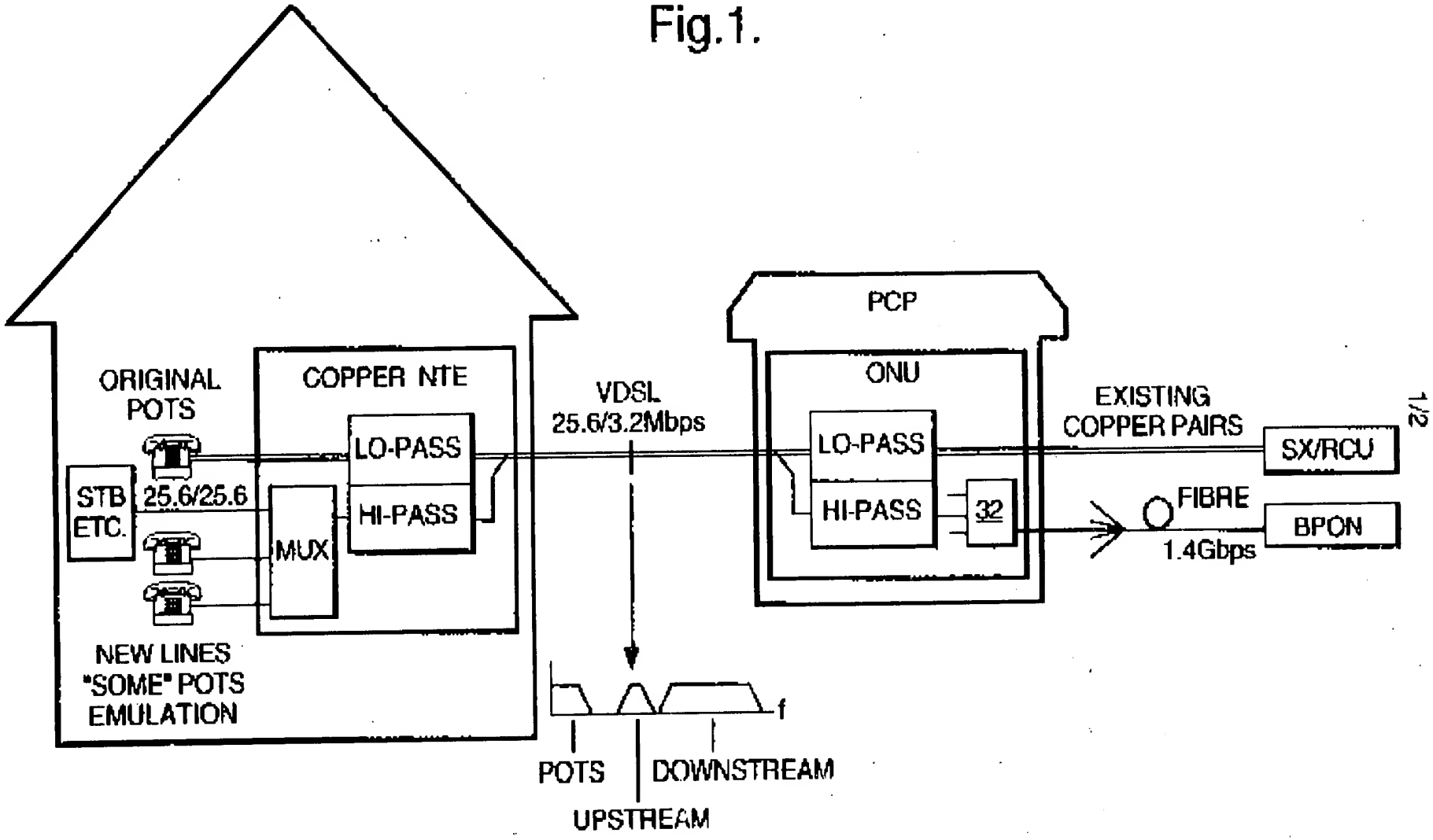
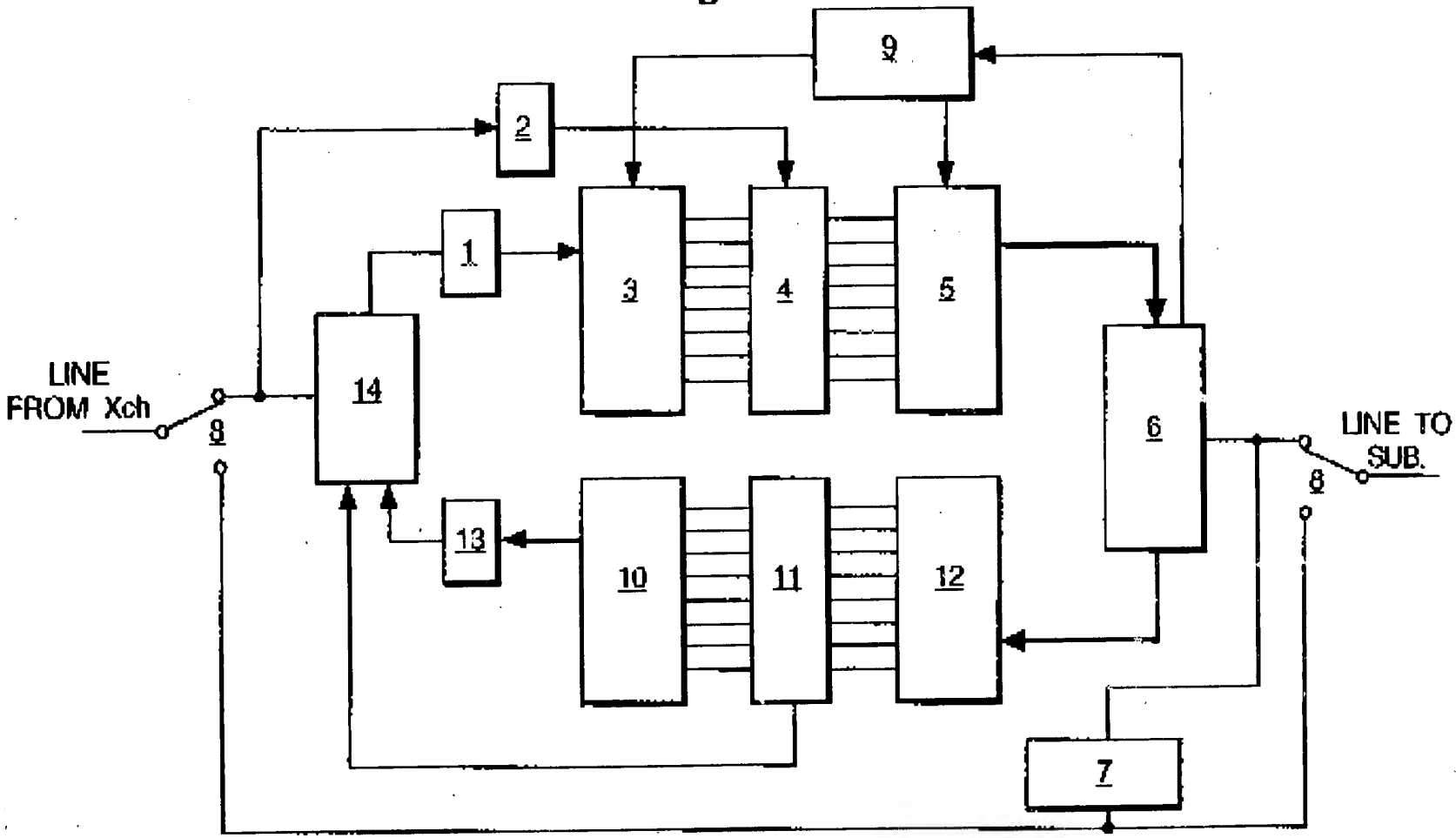

PCP
ONU
ORIGINAL POTS
COPPER NTE
VDSL 25.6/3.2Mbps
EXISTING COPPER PAIRS
LO-PASS
HI-PASS
STB ETC.
25.6/25.6
MUX
32
SX/RCU
FIBRE
1.4Gbps
BPON
NEW LINES "SOME" POTS EMULATION
f
POTS
DOWNSTREAM
UPSTREAM

Fig.2.



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